Nokia Customer Care
6015/6015i/6016i/6019i (RH-55), 6012 (RM-20) Series Transceivers

Troubleshooting – Antenna

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Introduction

The 6015/6015i/6016i/6019i, and 6012 incorporate a dual-band, internal/whip antenna combination. This antenna arrangement is used for both AMPS/CELL and PCS frequency bands. The whip is capacitively coupled to the internal antenna when extended. The internal antenna assembly consists of a Planar Inverted-F Antenna (PIFA) used for the cellular engine and an Inverted-F antenna (IFA) used for the GPS engine, which is placed on the side of internal antenna body.

The GPS antenna is only active on models that support the GPS engine (i.e., 6015/6015i/6016i/6019i).

Model	Type	Technology	Frequency (MHz)	Active GPS
6012	RM-20	Analog and CDMA IS2000	800	No
6015	RH-55	Analog and CDMA IS2000	800/1900	No
6015i	RH-55	Analog and CDMA IS2000	800/1900	Yes
6016i	RH-55	Analog and CDMA IS2000	800/1900	Yes
6019i	RH-55	Analog and CDMA IS2000	800/1900	Yes

Visual Quality Requirements

Whip Antenna

Check the following minimum visual quality requirements of the whip assembly:

- No physical cracks, bends, or mechanical defects
- No oil, corrosion, dirt, or particles
- Whip can be fully retracted and/or stowed without interference
- When fully retracted, antenna bottom stopper locks into antenna plug
- Antenna wire and/or cap is not missing, cracked, or bent
- Color of antenna (cap, plug, wire and straw) is a very dark grey
- Wire straw is present with no visible defects

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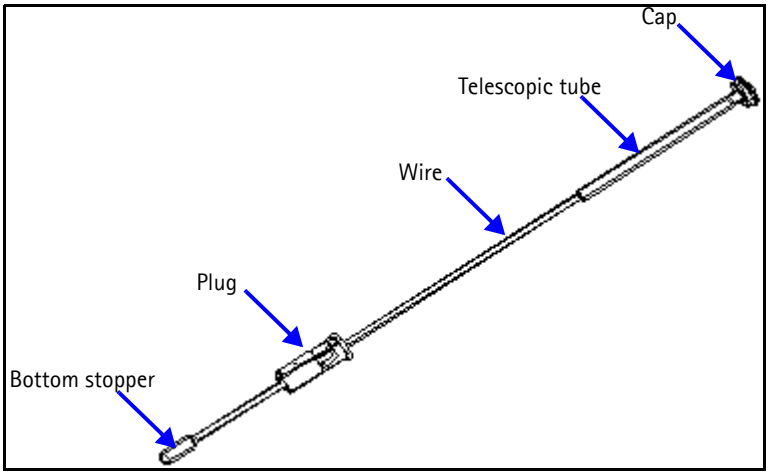

Figure 1: Whip assembly

Internal Antenna

Following are the minimum acceptable visual quality requirements of the internal antenna assembly:

- Gloves must be used when handling antennas. Do not touch the antenna radiator with bare hands.
- No visual cracks or mechanical defects.
- No oil, dirt, or particles are present on the parts.
- Radiator must be aligned with the plastic housing.
- GPS antenna contacts must be inside the plastic housing.
- Radiator must be flat with no warping.
- All pins must be at the same level.

Failures and Corrective Measures

Figure 2: Back view with the whip retracted (left) and whip extended (right)

Note in Figure 2 that when the whip is properly installed, the cap clicks into the D-cover when the whip is fully retracted.

Antenna Position into D-cover

The internal antenna and whip are assembled into the D-cover as shown in Figure 3. The whip must be inserted prior to inserting the internal antenna.

If no internal antenna is installed, the antenna gain will be degraded by more than 25 dB.

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Figure 3: D-cover assembly

- If the internal antenna is missing, install one. If the radiator looks obviously damaged, then replace the internal antenna.
- If the whip is missing, then remove the internal antenna, install a whip, and reinstall the internal antenna.

Internal Antenna

The internal antenna has a metal sheet (main antenna radiator) and a metal strip (GPS antenna radiator) attached to a plastic carrier. An IHF mini speaker is integrated inside the plastic.

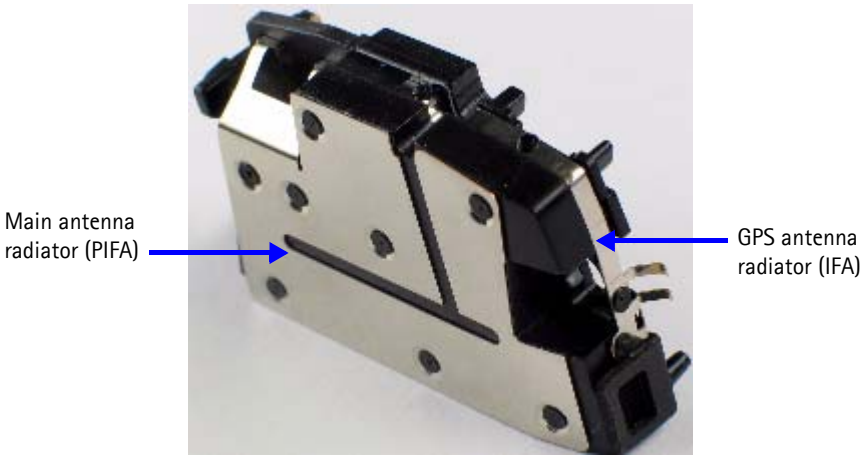

Figure 4: Internal antenna

Note: The GPS antenna is only functional on the models supporting the GPS engine.

Damaged RF Feed or Ground Pins

The main antenna and the GPS antenna have pins (spring clips) that should properly touch the PWB. If the RF feed pin of the main antenna does not touch the PWB, the antenna gain will degrade by more than 25 dB and the GPS antenna will be detuned. If the ground pin of the main antenna does not touch the PWB, the antenna gain may degrade about 5 to 10 dB and the GPS antenna will be detuned.

If the RF feed pin of the GPS antenna does not touch the PWB, then the GPS antenna gain will degrade by more than 20 dB. If the ground pin of the GPS antenna does not touch the PWB, the GPS antenna gain may degrade more than 5 dB.

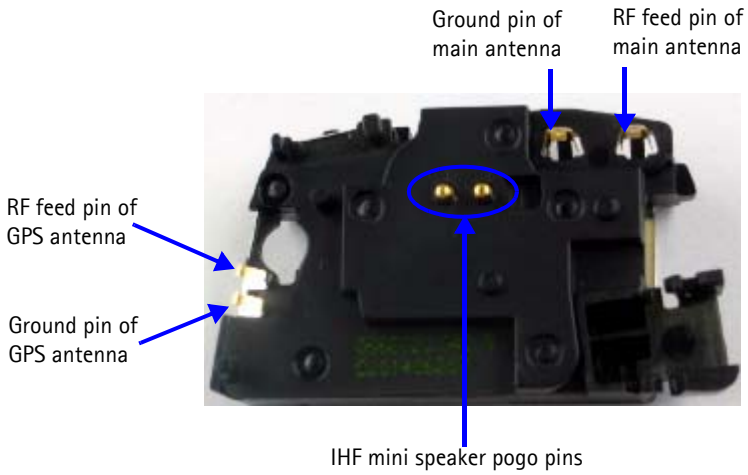
Ground pin of main antenna
RF feed pin of main antenna
RF feed pin of GPS antenna
Ground pin of GPS antenna
IHF mini speaker pogo pins

Figure 5: Back view of the internal antenna

- If either the RF feed pin or ground pin are broken or bent such that either pin will not touch the PWB, then replace the internal antenna.
- If the springs for the RF or ground pin appear damaged, then replace the internal antenna.

Damaged IHF Speaker Pogo Pins

In Figure 5, the two pogo pins on the back of the internal antenna should properly touch the PWB. If not, the PCS gain of the internal antenna could degrade about 2 dB and there will be no audio from the speaker.

Wrong Internal Antenna Installed

The internal antenna is mechanically similar to the internal antenna for the 2285, 2270, 2275 (RH-3 series) and the 2280 (RH-17) phones. There are three important differences between the internal antennas:

- Only the internal antenna for the 6015/6015i/6016i/6019i, and 6012 phones includes an IHF speaker.
- The slot pattern is very different among all three antennas.
- The radiators for the 2285, 2270, 2275 (RH-3 series) and the 2280 (RH-17) phones are marked with an “F” and an “H” respectively.

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Figure 6: Top view of the 6015/6015i/6016i/6019i, and 6012 internal antenna

Figure 7 shows the antennas for the 2285, 2270, 2275 and the 2280 phones. Ensure that these antennas are *not* installed.

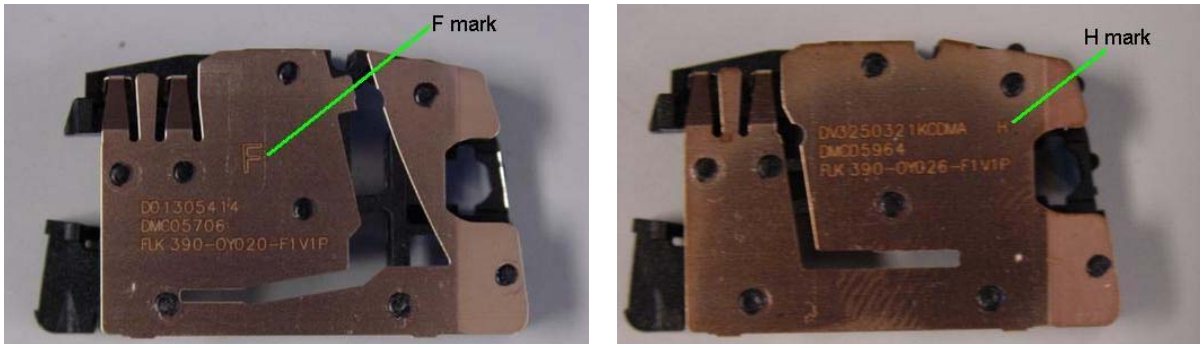

Figure 7: Top views of internal antenna for the 2285, 2270, 2275 (left) and the 2280 (right) phones

Installing the 2285, 2270, 2275 or 2280 antenna in the 6015/6015i/6016i/6019i, and 6012 phones is not compliant with Nokia's FCC submission because the 2285, 2270, 2275 (RH-3 series) antenna uses a single-band antenna (no PCS) and it does not have a GPS antenna. The 2280 (RH-17) antenna is not tuned correctly for the 6015/6015i/6016i/6019i, and 6012 mechanics.

- If the wrong antenna is installed, install the correct one.
- If the slot in the radiator has a significantly different shape, then install the correct internal antenna. Be aware that the shape of the slot can vary slightly. The length of the horizontal slot and the opening of the vertical slot can vary by few millimeters because the antennas are tuned for each batch of plastic frames.
- If there is any other obvious damage to the radiator (dents, corrosion), replace the antenna.
- If the pin gets stuck or has excessive friction in the plastic tube/guiding feature, then the spring will not work properly, and you should replace the antenna.

Obstructed IHF Speaker, RF Feed, and Ground Pads

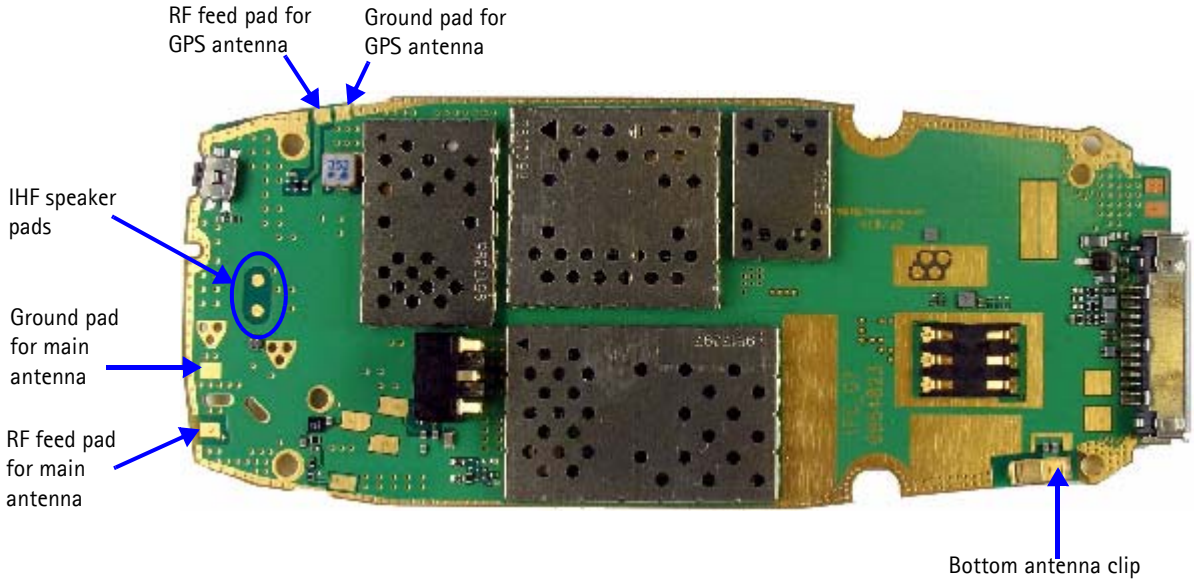
RF feed pad for GPS antenna
Ground pad for GPS antenna
IHF speaker pads
Ground pad for main antenna
RF feed pad for main antenna
Bottom antenna clip

Figure 8: PWB layout of IHF speaker, RF feed, and ground pads, as well as the bottom antenna clip

If any of the RF feed or ground pins are obstructed, removed, or covered, then the RF pin will not touch the PWB and the antenna performance will degrade. If any of the IHF speaker pads are obstructed, removed, or covered, the speaker's pogo pin will not touch the PWB and the antenna performance at PCS could degrade. See the "Damaged IHF Speaker Pogo Pins" section for antenna performance degradation if any pogo pin does not touch the PWB.

- If corrosion is present or the pad is missing, then you should replace the PWB and the phone.
- If a pad is obstructed or covered, then clear and/or clean the pad.

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Broken or Missing Bottom Antenna Clip

If the bottom antenna clip does not contact the whip stopper when the whip is fully retracted, the internal antenna gain will degrade by about 4-5dB at Cell band and 3-10dB at PCS band.

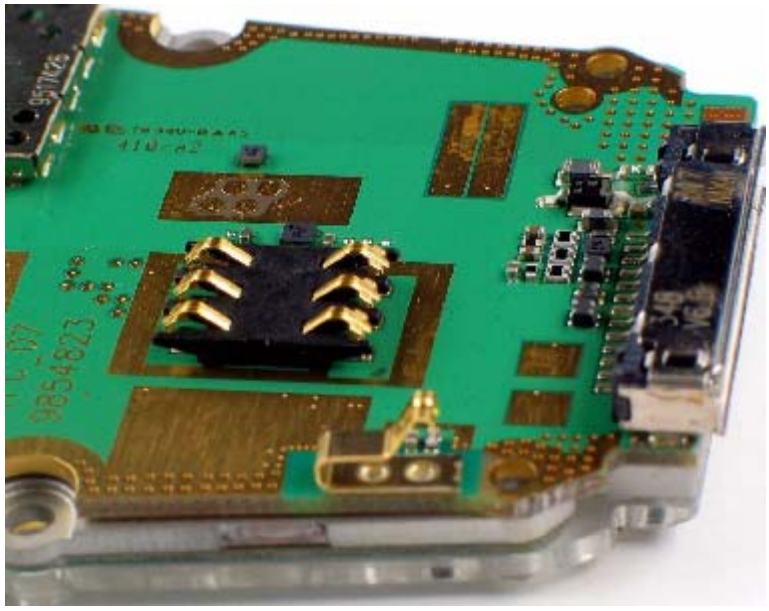

Figure 9: Bottom antenna clip

- If the antenna clip is installed backwards, is damaged, or is missing, then install a new bottom antenna clip in the correct position.

Obstructed Whip Stopper

If the whip stopper does not properly contact the bottom antenna clip, then the internal antenna gain will degrade by about 4-5dB at Cell band and 3-10dB at PCS band when the whip is retracted.

Figure 10: Whip stopper as shown when the whip is fully retracted

- If the whip stopper is corroded or blocked by the whip straw, replace the whip assembly.
- If the whip stopper is obstructed or dirty, remove the obstruction and/or dirt.

Grounding of Display Frame

Note that the display frame is grounded to the PWB through the two ground clips. The grounding of the display frame impacts the radiation performance of the phone.

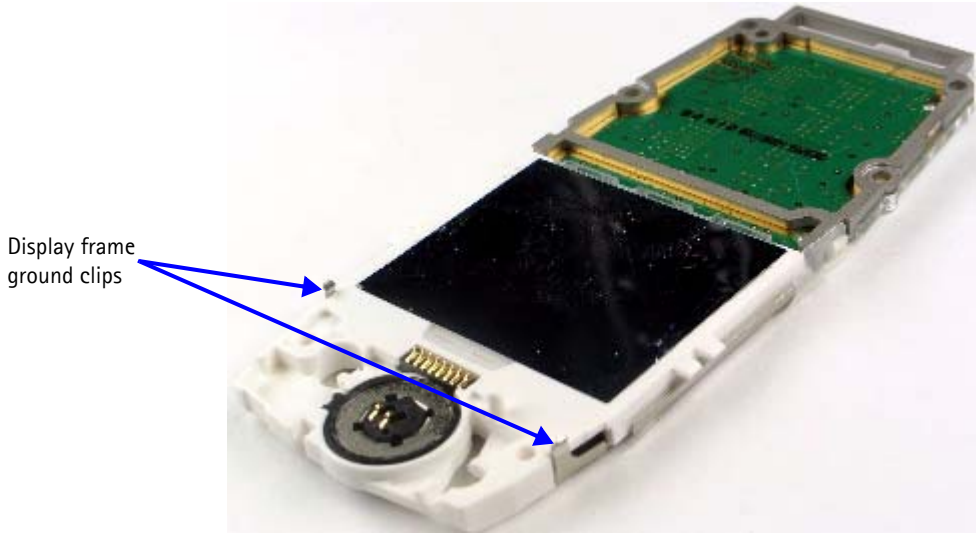

Figure 11: Back view of display assembly

- If the clips are not touching the PWB, are corroded, or are obstructed, replace the display frame.

The following figures show the contact between the display frame ground clips and the PWB in greater detail.

Figure 12: Contacts of display frame clips with side plating of the PWB

Figure 13: View of display ground clip in assembled phone with A-cover removed

Misinstalled Whip

The whip is locked into the D-cover when the internal antenna frame is installed. There is a feature in the plastic frame of the internal antenna that interlocks with the locking feature of the whip. The whip plug has the locking feature, and also has a key that is designed to make it difficult to install the whip plug with the wrong rotation. If the whip plug is installed with the wrong rotation, then the whip will not be visible as seen through the locking feature

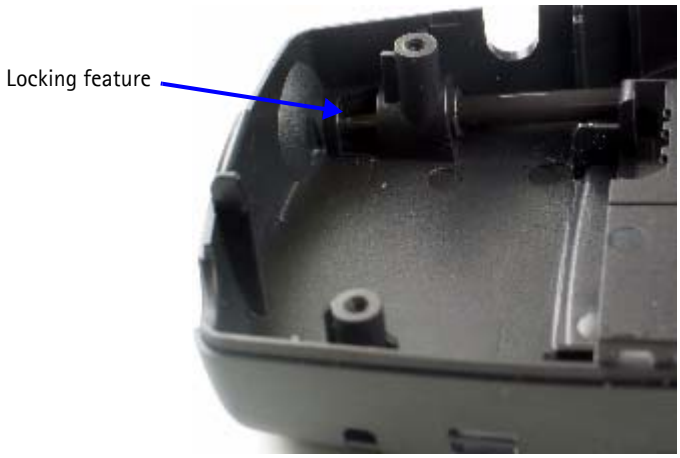

Figure 14: Locking feature for whip

- If the whip cannot be removed, replace the D-cover assembly. Otherwise, replace the whip antenna.

Damaged Whips

Figure 15 shows what the whip should look like when it is retracted and extended. If the whip is damaged, replace it.

Figure 15: Whip stand-alone in retracted and extended positions

Detuning Circuit for Bottom Antenna Clip

Figure 9 on page 10 shows the bottom antenna clip. The detuning circuit is right next to the bottom antenna clip. If the detuning circuit is not installed properly, then the internal antenna gain will degrade by about 4-5dB at Cell band and 3-10dB at PCS band. The GPS antenna gain will be degraded by more than 2 dB with the whip in the retracted position. The detuning circuit consists of a 1.2nH coil inductor and an 8.2 pF capacitor.

- If either the inductor or capacitor is missing, install one.

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Testing the CDMA Antenna

Calibration Factors

Define the AMS RF coupler CPL-8 calibration numbers using the test adapter MJF-28. Obtain the calibration numbers by utilizing a phone with known RF and antenna performance. Each test adapter should only require a single calibration on PCS1900 and GPS bands at used test frequencies. Additional calibrations should only be needed if the test adapter is substantially modified (reassembled, changed parts, dropped, etc.).

Calibration Factor for PCS1900 Frequency

Use a call box to turn on the transmitter of the phone with a known output power and antenna performance at the maximum output power (all bits up). Measure the transmitted power on the RF connector and through a coupler at CDMA PCS channel 1175. Use the difference between the transmitted and received powers as the calibration number (path loss on Cell band including coupler, cable, and attenuator path losses) for the coupler on Cell band.

The nominal value for power measured at the RF connector is 23 dBm. The coupler path loss is normally ~17...18 dB at the PCS band. If a 10 dB attenuator and a cable with ~1 dB loss is used, the total path loss is 28 to 29 dB and the measured power should be from -5 to -6 dBm [23 dBm - (28...29 dB)]. However, path loss has to be measured separately for every coupler because path losses vary depending on the setup, cables, and attenuator.

Measurement Procedure for Cell800/PCS1900 Phones

1. Place the phone with the display up in the test adapter (MJF-28) with its whip retracted.
2. Turn on the phone's transmitter at the PCS band on CDMA mode channel 1175 at maximum output power (nominal 23 dBm at RF connector).
3. Measure the RF power with a CPL-8 coupler. This represents the internal antenna to RF coupler measurement.
4. Turn the phone's transmitter off.

The CDMA antenna test fails if the measured power is outside the test limits.

Table 1: CDMA Measurement Test Limits

Min Measured Power + Coupler, Cable and Attenuator Path Loss	Nominal	Max Measured Power + Coupler, Cable and Attenuator Path Loss
20,0 dBm	23 dBm	26,0 dBm

Testing GPS Antenna (6015i/6016i/6019i)

Calibration Factor for GPS

In GPS test mode 3, the GPS receiver is fed with a CW signal. The GPS receiver should report C/No ratio of 35 dBHz with a -110 dBm signal level on the RF connector (-110 dBm + cable loss) at signal generator output. The reported C/No figure is recorded with the signal fed to the RF connector. The C/No value is read with a coupler engaged. Increase the GPS signal level until the same C/No value is recorded. Use the difference between the CW signal levels at the generator as the calibration number (path loss on GPS band including coupler, cable, and attenuator losses).

The nominal coupler path loss at GPS band is 14 to 17 dB. If you use a 10 dB attenuator and cable with 1 dB loss, the total path loss is 25 to 28 dB. The signal level at generator output must be -85 to -82 dBm [-110 dBm -(-25 dB to -28 dB)]. However, the path loss has to be measured separately for every coupler because the path losses vary depending on the setup, cables, and attenuator.

Measurement Procedure for GPS Antenna

1. Place the phone in the test adapter (MJF-28) with the display up and the whip retracted.
2. Turn on the CW signal generator [with power -110 dBm + coupler, cable, and attenuator path loss at GPS band] fed to the RF coupler.
3. Read the reported C/No figure with the test mode 3 three to four times to see if it is stable.

The GPS antenna test fails if the C/No value is outside the test limits.

Table 2: GPS Antenna Measurement Test Limits

Min	Nominal	Max
31,0 dBHz	35,0 dBHz	38,5 dBHz

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